1. For each of the following languages, give a push-down automaton.

   (a) (4 points) \( \{a^n b^{3n} : n > 0\} \)
   (b) (4 points) \( \{a^n x : n \geq 0, x \in (a + b)^*, |x| = n\} \)
   (c) (4 points) \( L = \) all strings over \( \{a, b\} \) that do not contain the substring \( bba \)
   (d) (4 points) \( L = \) Valid prefix operations over the alphabet 1, 2, 3, -, /.

\[
\begin{array}{c|c}
\in L & \notin L \\
3 & -2 3 1 \\
-1 2 & / 2 \\
-3 2 - 1 3 & -3 2 - 2 \\
\end{array}
\]

2. (8 points) Give both a CFG and a PDA for the language \( L \) All strings over \( \{0, 1\} \) that are not of the form \( 0^n 1^n \). \( L = \{0^n 1^n : n > 0\} \). Thus, 001, 100, 1001, 0110 \( \in L \), while 01, 0011, 000111 \( \notin L \)